about for some time by means of their cilia before they attach themselves to a suitable spot, and undergo their further development. These planulæ are necessarily swept away by strong currents to the further shores of a reef, and it has been shown experimentally by von Koch that they will not attach themselves in a strong current, or if attached, will loose their hold when a strong current is directed upon them. Although coral colonies grow larger by budding, they originate in every case from planulæ, and no great group of corals could grow in a place where the strong currents prevented planulæ from attaching themselves.—*March* 20].

EXPLANATION OF PLATE.

Fig. 1 represents a diagrammatic section through the surface soil of East Islet showing the alternate layers of sand and rock of which it is composed. Scale $\frac{1}{8}$ inch to the foot.

Fig. 2 shows the way in which a current striking a sloping bank is deflected upwards over its surface until it joins the superficial part of the main current at the upper edge of the reef.

III. "The Chemical Composition of Pearls." By George Harley, M.D., F.R.S., and Harald S. Harley. Received February 23, 1888.

Although there are many qualitative analyses of pearls, from our being unable, in their voluminous literature, to find any evidence of a quantitative analysis of their ingredients having been recorded, we undertook the examination of several varieties, of which the following is an account:—

1st. As regards oyster pearls. Of these three varieties were examined, British, Australian, and Ceylonese.

The qualitative analyses showed that they all had an identical composition, and that they consisted solely of water, organic matter, and calcium carbonate. There was a total absence of magnesia and of all the other mineral ingredients of sea-water—from which the inorganic part of pearls must of course be obtained. Seeing that ordinary sea-water contains close upon ten and a half times more calcium sulphate than calcium carbonate, one might have expected that at least some sulphates would have been found along with the carbonates, more especially if they are the mere fortuitous concretions some persons imagine them to be—a view we cannot endorse, from the fact that by steeping pearls in a weak aqueous solution of nitric acid, we are able to completely remove from them all their mineral constituents without in any way altering their shape, and but very slightly changing their naked eye appearances, so long as they are

permitted to remain in the solution. When taken out they rapidly dry and shrivel up. We shall take occasion to point out in our next communication, which will be on the microscopic structure of pearls, that a decalcified crystalline pearl bears an intimate resemblance to a decalcified bone, in so far as it possesses a perfectly organised matrix of animal matter. No phosphates whatever were found in any of the three before-named varieties of pearls.*

The next point being to ascertain the exact proportions of the substances composing the pearls, and pure white pearls being expensive, from our having ascertained that all the three kinds we were operating upon had exactly the same chemical composition, instead of making separate quantitative analyses of them, we simply selected two pearls from each variety, of as nearly the same size and weight—giving a total of 16 grains—and analysed them collectively, the result obtained being—

Carbonate of lime†	91·72	per cent.
Organic matter (animal)	5·94	,,
Water	2·23	,,
Loss	0·11	,,
	100·00	

From this it is seen that notwithstanding that mother-of-pearl consists of precisely the same ingredients, their proportions are quite different from what they are in fine, pure white pearls (we say fine pure white, because pearls vary greatly in purity, and those we analysed were good ones), which are infinitely denser, and consequently harder than the mother-of-pearl constituting the shells in which they are formed. The analysis of mother-of-pearl given in Watts' 'Dictionary of Chemistry' is—

Carbonate of lime	66·00	per cent.
Water	31·00	,,
Organic matter	2·50	,,

thus showing that while mother-of-pearl contains less than half the quantity of organic matter pearls do, it at the same time possesses close upon fourteen times more water. This fact appears to us all the more surprising as, not alone to the naked eye, but even under the

* Phosphates are referred to as being present in pearls by Rudler in his article in the 'Encyclopædia Britannica.'

† The carbonic acid was estimated by disengaging it with dilute sulphuric acid into a soda-lime tube, and calculating the increase in weight (as described by Lunge and Hurter in 'The Alkali Maker's Pocket-book'). The amount of the organic matter by noting the loss by weight after calcining—slightly moistening the mass with a solution of ammonium carbonate.

microscope, the structure of the mother-of-pearl of the shell and of pearls is almost identical.

[One can scarcely imagine that the analyst could have possibly employed in his investigation a piece of shell while it was yet in a fresh and consequently moist state.

As regards the hardness of pearls, again, it may perhaps be as well for us to remark that good pearls have a much denser texture than the majority of persons appear to suppose, as may be gleaned from the following facts.

On one occasion being desirous to crush into powder a split-pea sized pearl, we folded it between two plies of note-paper, turned up the corner of the carpet, and placing it on the hard bare floor, stood upon it with all our weight. Yet notwithstanding that we weigh over 12 stone, we failed to make any impression whatever upon the pearl, and even stamping upon it with the heel of our boot did not suffice so much as to fracture it. It was accordingly given to the servant to break with a hammer, and on his return he informed us that on attempting to break it with the hammer against the pantry table, all he succeeded in doing was to make the pearl pierce through the paper and sink into the wooden table, just as if it had been the top part of an iron nail, and that it was not until he had given it a hard blow with the hammer against the bottom of a flat-iron that he succeeded in breaking it.

In addition to the foregoing we may likewise take occasion to mention that shell-fish pearls are not nearly so easily dissolved in strong vinegar as the interesting tale of Cleopatra having taken a large pearl from her ear, and, after having dissolved it in vinegar, drunk it to the health of her lover Antony, would lead one to believe. For during our experiments we have learned that not only does it take many days to dissolve out the mineral constituents of a large pearl in cold vinegar, but that it even requires several hours to extract the mineral matter, by boiling vinegar, from a pearl not bigger than a garden pea. While in neither case, moreover, can the pearl be thus made to disappear, as from the fact of the organic matrix of a pearl being totally insoluble in vinegar, even after every particle of its earthy substance has been removed, it still remains of the same shape, bulk, and almost identical appearance as before. Hence we fear that if the Cleopatra legend is to be believed at all, it requires considerable modifications ere it can be brought into harmony with scientific truth. There is, indeed, only one way in which a large pearl, such as the one Cleopatra is said to have employed, could be dissolved in vinegar at a supper-table, and that is by having it completely pulverized by a hard hammer and a strong arm before applying the vinegar to it. For once the mineral constituents of a pearl have been reduced to the state of an impalpable powder, they not only readily dissolve, but

effervesce like a seidlitz powder—though much less strongly—when brought into contact with strong vinegar, and thus on their being diluted with water may be transformed into what might be called a cooling lover's potion, while from the organic matter having at the same time as the mineral constituents been minutely subdivided, its presence would scarcely be recognisable in the solution.]*

2nd. Composition of cocoa-nut pearls.

Qualitative analyses of pearls found in cocoa-nuts have been published by both Dr. J. Bacon and Dr. Kimminis.† But their analyses differ somewhat, for while Bacon found carbonate of lime and an organic substance akin to albumen, Kimminis met with nothing whatever in them except pure carbonate of lime. We subjected a portion of a garden pea sized cocoa-nut pearl, weighing 14 grains (kindly given to us by Messrs. Streeter) to analysis, and found that, like shell-fish pearls it consisted of carbonate of lime, organic matter (animal), and water.

The pearl which we examined was sent to Messrs. Streeter by their agent at Singapore (the same place from whence Bacon obtained his specimen), and as we stated last year (on June the 8th), when we exhibited at the *soirée* of the Royal Society both drawings and microscopic sections of it, we are exceedingly sceptical of the pearl we examined being in reality the product of a cocoa-nut, for the following reasons. It had all the external appearances of the pearls found in the large clams (*Tridacna gigas*) of the Southern Ocean, being perfectly globular, with a smooth, glistening, dull white surface, and resembling them exactly in microscopic structure. Besides which in chemical composition it bore no similarity to cocoa-nut milk, to which it is supposed to be related. For cocoa-nut milk is said to contain both the phosphate and the malate, but not the carbonate of lime. That there are pearls found in cocoa-nuts we do not presume to deny; all we mean to say is that we are doubtful if the specimen we examined had such an origin.‡

3rd. As regards mammalian pearls.

These so-called pearls have been met with in human beings and in

* Added March 27th, 1888.

† See 'Proceedings of the Boston Society of Natural History,' vol. 7, 1861, p. 290; vol. 8, 1862, p. 173; 'The Tropical Agriculturist,' April, 1887; and 'Nature,' 16th June, 1887 (Dr. Hickson and Mr. Thiselton Dyer).

‡ Since this paper was in type I have kindly had my attention drawn by Dr. Hickson to a letter from J. G. F. Riedel, of Utrecht, in 'Nature,' 15th September, 1887, in which he states that in 1886, while in North Celebes, he found a pearl "in the endosperm of the seed of the cocoa-nut." And that he has in his possession "two melati pearls (*Jasminium sambac*); one tjampaka pearl (*Michelia longifolia*), found in the flowers, according to the natives. One of the cocoa-nut pearls has a pear-shaped form, the length being 28 mm. The common name amongst the natives for this kind of pearl is mustika."—G. H., 1st March, 1888.

oxen. The first person who kindly called our attention to those of the ox was the late Professor Pannum, of Copenhagen, who in 1874 presented us with some specimens he had found in the gall-bladder of a Danish ox.

In so far as naked eye appearances are concerned, a good specimen of the variety of pearl now spoken of is quite undistinguishable from a fine specimen of oriental oyster pearl, from its not only being globular in shape, and of a pure white colour, but from its also possessing the iridescent sheen so characteristic of oriental oyster pearls of fine quality.

In chemical composition, however, mammalian pearls bear no similarity whatever to pearls found in shell-fish, for they are composed of an organic instead of an inorganic material, namely cholesterin. In minute structure again, they bear a marked resemblance to the crystalline variety of shell-fish pearls.

The quantitative analysis of human pearls yielded in 100 parts—

Water	2·05
Solids	97·95

The solids consisted of—

Cholesterin	98·63
Animal matter..........	1·37

From this it is seen that human pearls are in reality nothing more nor less than exceedingly pure cholesterin biliary concretions.

This note on the chemical composition of pearls is intended as a prelude to a paper we purpose shortly laying before the Society on the microscopic structure of the different varieties of pearls we had the honour of exhibiting sections of with the lime-light, as well as microscopic drawings, at the *soirée*, on the 8th June, 1887, and of which a detailed report was given in the 17th No. of the 'Cheltenham Ladies' College Magazine,' pp. 37—42, by J. F. Muspratt.

IV. "On the Vertebral Chain of Birds." By W. K. PARKER, F.R.S. Received March 8, 1888.

A few years ago I noticed a remarkable fact in the development of the Green Turtle (*Chelone viridis*), namely, that whilst *thirteen* myotomes are developed in the cervical region, the intercalary vertebral segments found afterwards are only *eight*.*

More recently, whilst working out the development of the vertebræ in various types of Birds, it struck me that we have in these high forms creatures in which the vertebral chain has been greatly

* See "Challenger" Reports, *Zoology*, vol. 5, Plate 1, fig. 3, pp. 48 and 50.